



# Where Do We Learn to Behave Like Grownups?

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*For some problems, such as autonomous vehicles, we only begin to understand the technical issues when we are able to look back on the different ways that researchers have approached the problem.*

Over the past two decades, the self-driving car has proven to be one of the most exhilarating topics in computer science research. It leaped into public view in October 2005 with the DARPA Grand Challenge, an event that demonstrated to the public that computer technology was capable of navigating an automobile over a closed course, that is, a course devoid of ordinary traffic but still occupied with other self-driving cars.<sup>1</sup> The technology has been commercialized, even though no fully autonomous consumer car has been approved for sale. Hence, it is appropriate, if not required, that we find a *Computer* article on autonomous

vehicles in our body of knowledge. The most prominent among the articles that we have published on this topic is “The Social Life of Autonomous Cars.”<sup>2</sup>

It is not hard to remember the excitement that followed the DARPA Grand Challenge. David Patterson, then the president of the Association for Computing Machinery, called for a massive investment in

autonomous vehicle technology. “If we could reduce the costs of automobile accidents by US\$30 billion per year in the U.S., a single year’s savings would exceed the

## ARTICLE FACTS

- » Article: “The Social Life of Autonomous Cars”
- » Author: Barry Brown
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government's investment in academic computer science research for the last 50 years," he wrote. "Given the tremendous progress over the last year as a result of this competition," he continued, "doesn't it seem plausible that if we invested, say, 5% of the potential savings in computer science research for five to seven years, that we could at least halve traffic accidents down the road?"<sup>3</sup> The leader of the winning team at the DARPA challenge, Sebastian Thrun, supported this assessment and argued that the "benefits to society will be enormous."<sup>4</sup>

self-driving cars, which are still in the early stages of development." Instead, he wanted to illustrate the fact that driving was something more than a mechanical operation. It was "also a complex social activity."<sup>5</sup> Drivers can be gracious or competitive, kind or vengeful. They rarely exchange words with their colleagues on the road (or at least none that penetrate beyond their windscreens), yet their communications can be as clearly articulated as anything spoken. "I am moving into that lane," they might say with a motion of the car. "I'm letting you go

personality and many other factors," noted the author, Talib Rothengatter. He further argued that the field has made remarkably little progress in developing comprehensive models that incorporate all of these ideas. In part, the problems arise because we employ multiple psychological frames for a single trip and often engage multiple frames simultaneously. We have one frame for minimizing time, another for maximizing safety, a third for engaging our passengers, a fourth for engaging the others on the road, and a fifth for navigating.<sup>6</sup>

### But when we start to view driving as a social activity, we place the problem of automated vehicles in a new category.

In the years that have followed, we have gained a more realistic view of this technology. The accomplishments of Thrun and his contemporaries have been tremendous. There have been substantial improvements in autonomous vehicle technology over the past 15 years. At the same time, there has been some clear evidence of the limitations of self-driving cars. In 2018, such a car crashed in Tempe, Arizona, killing a bystander.<sup>5</sup>

Barry Brown, the author of "The Social Life of Autonomous Cars," recognized that the problem of building a self-driving passenger car was difficult. He also realized that there were not a lot of data that he could use to study the safety of this technology. "We're in the midst of a global field test of autonomous driving technology," he wrote, "yet results from these tests are proprietary, with little publicly available data." To get a better understanding of this technology, he developed a new method of assessing autonomous technology using videos that were freely accessible from YouTube and other sites.

"My goal here," he explained, "isn't to critique the current generation of


in front of me," suggests a deacceleration. "I am moving ahead no matter what you may be doing," is implied by a steady closing of distance.

But when we start to view driving as a social activity, we place the problem of automated vehicles in a new category. It is no longer merely a problem of path planning. It becomes a subtle problem in artificial intelligence (AI). It requires that we build a system that responds to human actions with new actions that are recognizably rational to a human being. It means we are doing a Turing test on wheels. We are doing it with not a single system but with dozens. We are doing it at 60 mi/h.

We are also trying to develop this smart system in an area of human behavior that has not had a great deal of study. It is "astonishing that traffic and transport," explained an early survey of the field, "which occupies every human being in society for at least two hours a day, has attracted so little attention from psychologists in the past."<sup>6</sup> This survey noted that driving psychology involves several factors. "Driver behavior involves performance, attitude, motivation,

To date, much of the literature has speculated about the relationships among these frames but has yet to build a commonly accepted unified model of driving psychology. Still, the "automotive psychologists" recognize the value of understanding the thought processes behind driving. "The transport system," noted Rothengatter, "imposes a cost on society that is increasingly considered unacceptable." He further added that part of the problem is due to the "predominance of private vehicle usage."<sup>6</sup> So, our contribution to the body of knowledge both reminds us of the substantial advances that we have seen in automated vehicles and also that the problem of creating fully automated vehicles may ultimately be equivalent to the problem of producing general AI.

### ACKNOWLEDGEMENT

For these columns, "Body of Knowledge" takes its information from a report prepared by the IEEE Publications office on 15 November 2019, and the statistics were current as of that date. Other citation services can and do give different numbers. 

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